Aug. 28, 1934. T. A. SPERRY 1,971,586

ARC QUENCHER

Filed March 25, 1933

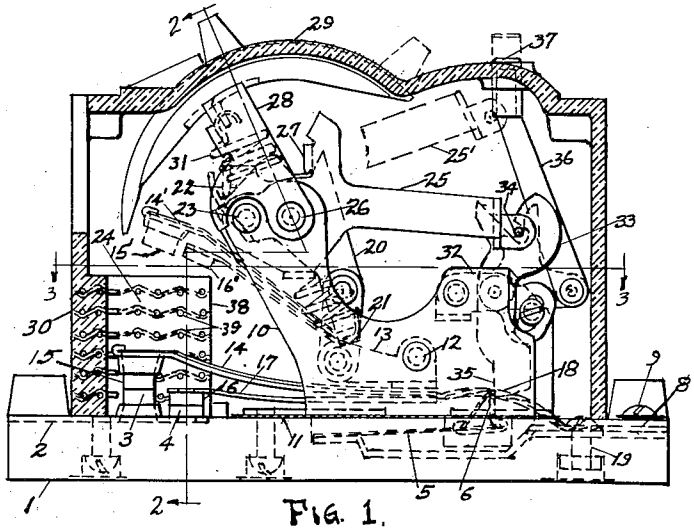


FIG. 1.

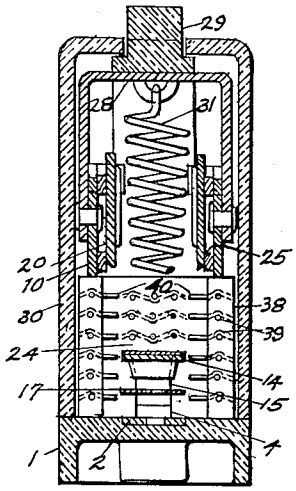


FIG. 2.

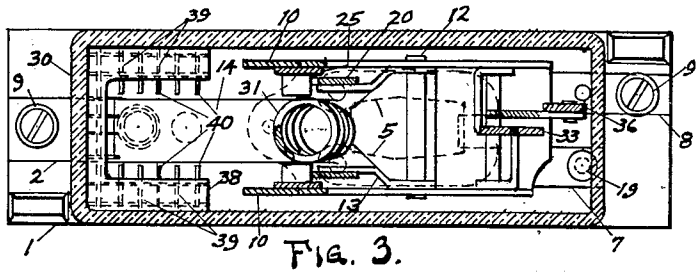


FIG. 3.

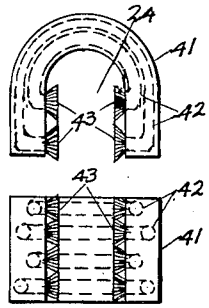


FIG. 4.

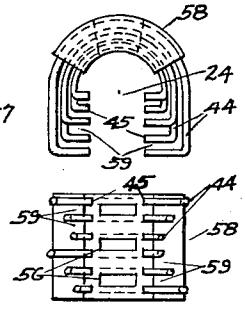


FIG. 5.

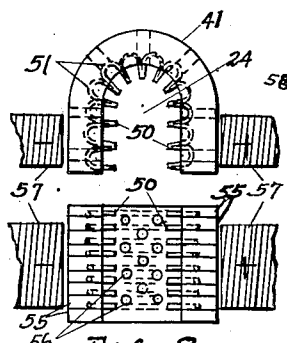


FIG. 8.

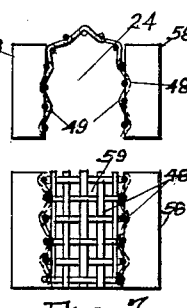


FIG. 7.

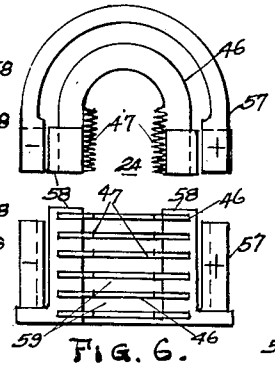


FIG. 6.

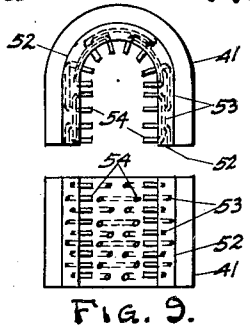


FIG. 9.

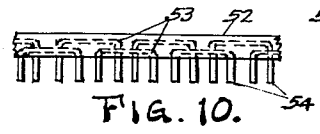


FIG. 10.

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UNITED STATES PATENT OFFICE

1,971,586

ARC QUENCHER

Theodore A. Sperry, Indianapolis, Ind., assignor to Electric Devices Corporation, Indianapolis, Ind., a corporation of Indiana

Application March 25, 1933, Serial No. 662,787

20 Claims. (Cl. 200—144)

This invention relates primarily to mechanisms for breaking or interrupting electric currents, and to application to circuit breaking apparatus, and more specifically to arc extinguishing and destroying devices for circuit breakers of the air gap type. A primary object of the invention is to provide an arc breaking and extinguishing device that is capable of destroying arcs formed during the interrupting of relatively large currents without destructive or severe arcing with consequent injury to the breaker contacts and mechanism.

A further object is to provide an arc quenching device wherein the arc incident to the separation of the breaker contacts is reduced to a minimum and rapidly cooled and dissipated before injury to or burning of the contacts may transpire. Another object is the provision of a device of this character that may be constructionally incorporated in a breaker mechanism, or may be applied as an attachment thereto. A further object is to provide a device that will instantly and simultaneously break an arc, during its process of formation, into a very large number of minute, short arcs of very small relative value, each having a relatively large area of cooling surface in contact therewith, to dissipate these minute arcs as formed. A further object is to provide a very large number of conductor points in close proximity, each projecting into the path of a formed arc, with inter-related magnetic action, to attract, break up and diffuse an arc during its formation.

In the accompanying drawing, forming a portion of this specification, Figure 1 is a side elevation, partially in section, of an approved type of air gap circuit breaker with one form of this arc quenching device shown in section. Figure 2 is an end elevation of the assembly taken on line 2—2 of Fig. 1, and Figure 3 is a plan view on line 3—3 of Fig. 1. Figures 4, 5, 6, 7, 8, and 9, are plan and elevation views of the arc quenching device in modified forms, and Figure 10 is a detail, on enlarged scale, of the form shown in Fig. 9.

With more detailed attention to the drawing, the numeral 1 indicates a base of insulating material, carrying an entrance conductor 2, a fixed arcing contact 3, and a fixed current contact 4. A warping thermal element 5, carrying an insulated trip catch 6, is fixedly mounted within the base 1 in contact with a conductor 7 and an outlet conductor 8, the conductors 2 and 8 being provided with attachment screws 9. A breaker housing 10 is mounted on the base 1 with an insulation sheet 11 therebetween, and carries a cross shaft 12 to pivotally support a hinge member 13 to which is secured a flexible contact arm 14 carrying a movable arcing contact 15, and a contact arm 17 carrying a current contact 16, said contacts 15 and 16 registering, when in closed position, with contacts 3 and 4 respectively, a flexible conductor 18 interconnecting said contact arms with the conductor 7 as by the screw 19. A toggle linkage, with links 20 and 21, pivotally engages the hinge 13 and releasably and pivotally co-acts with a release arm 25 and with the housing 10 to open and close the contact arms 14 and 17, the arm 25 being pivoted upon the housing 10, as at 23, and carries a pivot pin 27 for the link 20, and the housing 10 carrying a similar pivot pin 22 for the link 20. A handle 28 pivotally mounted, as at 26, carries a winged knob 29 which projects through an opening in a cover 30, a helical spring 31 operatively connecting the handle 28 with the toggle link 20. An adjustable bracket 32 carries a trip lever 33 which coacts with a pin 34 in the arm 25 to releasably engage the arm 25, the other extremity 35 of said lever forming a strike to releasably coact with the stop or catch 6, a flag bar 36 terminating in a re-setting button 37, serving to indicate automatic, as distinguished from manual, action of the breaker. The numerals 14', 15' and 16' indicating the open circuit position of the contact arm 14 and the contacts 15 and 16 respectively, and 25' indicates the automatically released position of the arm 25.

It should be observed that the herein described breaker is an adaptation of the applicant's copending application, Serial No. 644,908, filed Nov. 29, 1932, and the arc quenching device described herein is directly applicable to said breaker and to modifications thereof, and should be considered therewith.

In consideration of the arc quenching or disbursing element per se, which is the essential feature of this application, the numeral 38 indicates a wall or frame, preferably of insulating material, surrounding three sides of the breaker contacts which carries and supports a metallic mesh 39, which may or may not be woven in structure, embedded at spaced intervals and preferably in parallel relation, throughout the frame, the ends or extremities of the mesh wires, as at 40, projecting inwardly from the frame into the arc chamber 24, surrounding the breaker contacts. These extremities 40 make a very large number of closely interspaced points, or miniature "lightning rods", projecting into the periphery or path of the arc, the arc being drawn into, and interspaced between, this multitude of points, and broken up into a vast number of very short, infinitesimally small arcs, the potential drop of which, between adjacent arcs, is relatively great in proportion to the size of the arc, so that the individual arc is maintained but for an instantaneous period of time, and the relative area of the circumference of the exposed wire presents a greatly enlarged surface of cooling metal which chills the miniature arc and prevents damage to

or destruction of the quenching points. It is readily apparent that this construction may take a variety of forms without departing from the principle or basic feature of the construction, as is illustrated in the various forms shown in the views of Figures 4 to 9 inclusive, wherein 41 indicates the frame or wall surrounding the arcing chamber 24, 42 indicating a plurality of flexible cables, which may be braided, woven, twisted or otherwise secured together, or merely laid in parallel relation, the ends 43 preferably being spread apart or expanded to cover a considerable area. 44 indicates a plurality of formed wires or rods with spaced ends 45, while 46 shows a series of spaced metallic plates the edges of which are shredded or minutely expanded, as at 47, to present the same multiplicity of points in the arc path. The wire mesh may be placed vertically, as at 48 in Fig. 7, each bend or "hump" of the wire presenting a point for arc contact, or the wires may be bent, as at 51, to present points 50 to the arc, the wires preferably being positioned in parallel, spaced relation. In Fig. 9 an inner flexible strip 52 carries a plurality of closely spaced staples or U-shaped members, after the manner of a standard form of file card, with the points 54 projecting toward the arc, each staple of which may be considered to form a miniature magnet under the induction effects of the arc passage, the details of this formation being more clearly designated in Fig. 10. It is also apparent that the frame or wall 41 may be composed of sheets or strips of desired thickness of insulating material, as at 55, and also that suitable openings or slots 56 may be provided as desired for ventilating, cooling, arc passage, and other purposes within and through the wall 41, and also that the magnetic action of the construction may be supplemented by supplementary permanent or electro magnets suitably positiond, as at 57, within or without the wall 41 of the structure.

It is also evident that the wire or elements forming these constructions may be either insulated or bare, or the body portions of the elements may be insulated and the points only be bare. They may be made of various metallic combinations, either magnetizable or conductors in nature, and proportions may be widely varied without transcending the scope and spirit of the invention. It is plainly evident, too, that the support or frame member may be made integral with the breaker base, with the cover for the breaker, or as a separable attachment to either, or positioned in any desirable manner. The support member may be made to essentially cover the metallic elements, or it may be made a mere pedestal or column as at 58, to support or contain a portion only of the elements, leaving the major portion thereof exposed, as at 59, to increase the cooling area of said elements and to form de-ionizing spaces therebetween. The proximity or spacing of the elements may be gaged, and diameter and formation of the wires or elements may be established, as experience and operative deduction may determine to give the most satisfactory and efficient results.

What is claimed as new is:—

1. In an arc quencher for a circuit breaker having separable contacts, a wall of insulating material surrounding but three sides of the separable contacts when closed, a contact supporting and moving arm passable between the two spaced wall edges and in the space therebetween, a plurality of metallic elements each composed of a plurality of strands in cable-like formation supported by said wall, the ends of said strands projecting in point-like manner into the arc zone of said breaker in closely spaced interrelation with one another.

2. In an arc quencher for an electric circuit breaker, a formed substantially tubular wall of insulating material essentially surrounding the arc area of said breaker but having a longitudinal gap therein, a contact positioned at one end of the tubular wall, another contact movable into the wall from the opposite end, a supporting arm therefor and movable through the gap in the wall, said wall supporting a plurality of closely spaced conducting elements each composed of a plurality of associated strands in cable-like formation, the extremities of said elements projecting toward said arc area to form a relatively large number of pointed projections within said area, to disperse and disintegrate an arc formed within said area.

3. An arc extinguisher for a circuit breaker including a non-inflammable insulating support substantially tubular but have a longitudinal gap therein, a plurality of separable contact members, one positioned adjacent one end of the tubular support and the other movable from the opposite end toward and from the first mentioned contact, a swinging arm for the last mentioned contact and movable in the gap, a plurality of cable-like magnetizable elements embedded within the support and including a plurality of finely divided point-like projections extending inwardly into the arcing chamber and presenting a large number of closely spaced points towards an arc which may be formed between said contacts on either side thereof, and at a position immediately adjacent the initial formation of said arc.

4. A device as defined by claim 3, characterized by said elements consisting of a plurality of essentially parallel metallic wires in rope-like form in spaced and insulated relation.

5. A device as defined by claim 3, characterized by each of said elements comprising a plurality of insulated metallic members in bunched formation and having its arcing chamber exposed portion comprising a plurality of metallic points in open spaced relation.

6. In an arc quenching circuit breaker, the combination of but a single, stationary, circuit included contact, another contact also included in the circuit and movable toward and away from the first mentioned contact for closing and opening the circuit respectively, and arc quenching means positioned immediately adjacent the first mentioned contact and in juxtaposition to the path of the second mentioned contact immediately adjacent the first mentioned contact and arranged to disperse and disintegrate the arc formed between the separating contacts at the formation of said arc, said means including a plurality of point-like metallic projections extending toward the path of movement of the second mentioned contact at two opposed sides thereof, said point-like projections being interconnected by metallic conductors embedded within insulation walls surrounding a portion of said path.

7. A device as defined by claim 6, characterized by said arc quenching means including openings providing ventilation into the arcing chamber formed by said arc quenching means adjacent the stationary contact.

8. An arc quencher of the type specified in claim 2 in which the arc is confined and destroyed

within said tubular walled arc area by dispersion upon the extremities of said associated strands without impinging upon said cable-like formation embedded in said walls.

9. An arc extinguisher as described in claim 3 in which the point-like projections only lie within the range of the arc action and among which projections only the arc is dissipated and destroyed.

10. An arc extinguisher for a circuit breaker consisting of a plurality of metallic cables, each composed of a plurality of strands, supported in spaced relation about the arcing area of said breaker, the extremities of said strands in said cables being dispersed one from the other and projected toward said arcing area, an arc formed within said area being attracted to and dissipated upon and among said dispersed extremities of said strands.

11. An arc quencher for a circuit breaker consisting of a plurality of spaced metallic elements, each element being formed of a plurality of insulated metallic wires in essentially parallel formation, the extremities of each element being positioned within the arcing area of said breaker, the extremities of said wires being dispersed one from the other, an arc when formed within said area being impaled upon and dissipated between said interspaced extremities.

12. An arc extinguisher for a circuit breaker consisting of a plurality of spaced flexible cables partially surrounding the arc area of said breaker with the extremities of said cables projecting within said arc area, said cables each being formed of a multiplicity of metallic strands insulated one from the other, the extremities of said strands within each cable being spread out in interspaced relation, forming a multiplicity of interspaced projections within said arc area upon which an arc therein formed is broken up into a multiplicity of minute arcs and destroyed without injury to said cables or said projections.

13. An arc quencher for a circuit interrupter including a plurality of metallic wires assembled in parallel bunched relation and formed to partially surround the separable contact area of said interrupter, the ends of said wires projecting into said contact area and spreading out in dispersed relation one to another to form an essentially uniform wall of spaced metallic points adjacent said contact area to attract and disintegrate an arc formed within said area, the bunched portion of said wires being included in an insulation wall relatively surrounding said contact area.

14. An arc quencher as described in claim 13 in which each of said metallic wires is formed into essentially the form of a horse-shoe magnet with each terminal thereof projecting into opposed portions of said contact area, supplementary magnet terminals being positioned externally of said opposed portions to assist in attracting said arc toward and into said spaced point-like terminals to become disintegrated and dispersed thereon.

15. In an arc quencher for an electric circuit breaker, a formed wall of insulating material essentially surrounding the arc area of said breaker, said wall supporting a plurality of closely spaced conducting elements, each element being composed of a plurality of essentially parallel wires bunched together in strand-like formation, the extremities of said elements projecting toward said arc area to form a relatively large number of pointed projections adjacent said area, to disperse and disintegrate an arc formed within said area.

16. An arc quencher for a circuit breaker consisting essentially of a supporting frame of insulating material, a plurality of formed members maintained in spaced relation by said frame, said members being composed of a plurality of associated wires grouped together in essential parallelism, an arcing chamber formed within said frame, the exposed ends of said members projecting inwardly toward said arcing chamber, and forming a large number of pointed conductors adjacent said chamber to attract an arc formed therein and disintegrate it into a large number of minute arcs between said points to rapidly destroy said arc within said chamber.

17. An arc quencher for a circuit breaker including a non-inflammable support, a plurality of separable contact members, a plurality of magnetizable members each composed of a plurality of longitudinal conductors arranged in strand formation and terminating in a plurality of divided point like projections extending inwardly toward an arc which may be formed between said contacts during their separating movement.

18. An arc destroying member for an electric circuit breaker consisting essentially of a multiplicity of metallic points forming a perforate but nearly contiguous wall surrounding a portion of a passage within said member, a movable contact operative within said passage, said metallic points consisting of the exposed terminals of a plurality of metallic conductors arranged in a plurality of spaced bundles supported by said member, said wall of points serving to attract and divert an arc formed within said passage and disperse it into a great number of minute arcs between said points the destructive effect of which will each be insignificantly small.

19. An arc quencher in connection with a circuit breaker formed of a multiplicity of metallic points forming an essentially contiguous enclosure surrounding a portion of the path of movement of the separating contacts of said breaker, said points being the exposed terminals of cables formed of a plurality of wire-like elements supported in spaced relation, said terminals being angularly separated and projecting into the zone of activity of an arc formed between said separating contacts, to break up said arc and disperse it in the form of a multiplicity of minute arcs between said terminals, each terminal serving to cool its minute arc and lower its potential to rapidly destroy said arc.

20. An arc extinguisher composed essentially of a plurality of metallic elements formed in cable-like groups partially surrounding the arcing portion of an electric device, said elements terminating in angularly dispersed projections adjacent said arcing portion, said elements being of magnetizable material and each forming a temporary magnet under the action of the arc formed in said electric device, each element terminating on opposite sides of said arc, said arc being influenced from its inception to its maximum by said opposed terminals and drawn into and impaled upon said dispersed terminals in the form of minute arcs upon and between said dispersed terminals.

THEODORE A. SPERRY.